Activity of YASKAWA for Industrie 4.0
-Focus on Robotics-

1. Introduction of our company and products.
2. Concept for Our Industrie 4.0.
3. YASKAWA’s Industrie 4.0 for Robotics.
4. Expectation for Industry segments.

April 15, 2015

YASKAWA ELECTRIC CORPORATION
Technology and Development Division
Hiroshi Ogasawara

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### 1. Profile

<table>
<thead>
<tr>
<th>Corporate Name:</th>
<th>YASKAWA Electric Corporation</th>
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<tbody>
<tr>
<td>Establishment Date:</td>
<td>July 16, 1915</td>
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<tr>
<td>Head Office Location:</td>
<td>2-1 KurosakiShiroishi, Yahatanishi-ku, Kitakyushu Fukuoka Japan</td>
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<tr>
<td>Capital:</td>
<td>23,062 million yen</td>
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<tr>
<td>Number of Employees:</td>
<td>Consolidated 14,579</td>
</tr>
<tr>
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<td><em>including temporary employees</em></td>
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<tr>
<td>Consolidated Net Sales:</td>
<td>363,570 million JPY (FY 2013*)</td>
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<td>Main Business:</td>
<td>Motion Control</td>
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<tr>
<td></td>
<td>(AC servomotors, controllers and AC drives)</td>
</tr>
<tr>
<td></td>
<td>Robotics</td>
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<tr>
<td></td>
<td>System Engineering</td>
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*FY 2013 means the consolidated fiscal year from March 21, 2013 to March 20, 2014.
1.2 Business History

Establishment 1915

1950

1980

1990

2000

2010

Electric motors (for coal mining)

Electric systems

Steel, paper, film plants, water supply plants and sewage treatment plants

DC Servomotors

AC Servomotors

Industrial Robots

AC Drives

Clean/Vacuum Robots

FPD Robots

Key product transition

Application of motor and electric system technologies to the growing mechatronic field

Shifted our focus on the mechatronic field

1950 - development of “Minertia Motor”

1977 - development of “MOTOMAN-L10”

1969 - applied for trademark of “Mechatronics” (registered in 1972)

2015 Vision

Environment & Energy Business Field

Mechatronic Solution Business Field

Robotics Human Assist Business Field

Representative Director
Chairman of the Board
President (FY2010–)
Junji Tsuda

Founder
Keiichiro Yasukawa

First President
Daigoro Yasukawa

1958

New Generation Robots

Next Generation Robots
1.3 Business Overview

Motion Control

Core products
AC servo motors and controllers, Linear servo motors, General purpose AC drives, Power conditioners, Motor drive systems for EV, etc.

Robotics

Core products
Arc and spot welding robots, Painting robots, Handling robots, FPD glass sheet transfer robots, New generation robots, Semiconductor wafer transfer robots, Biomedical robots etc.

System Engineering

Core products
Electrical systems for steel plants
Electrical instrumentation systems for water supply plants and sewage treatment facilities, Large-scale wind power generator and converter etc.

Other

Core products
IT-related services, Logistics, etc
1.4 Sales Breakdown by Business Segment and Region

**Business Segment**

- **Motion Control**: 44%
- **Robotics**: 34%
- **System Engineering**: 10%
- **Other***: 12%

Net Sales: ¥363.6 bn.

**Region**

- **Japan**: 41%
- **Overseas**: 59%
  - **Asia Excluding China**: 11%
  - **China**: 19%
  - **Europe**: 12%
  - **The Americas**: 16%

Net Sales: ¥363.6 bn.

*Other is a business segment for activities that are not included in the reporting segments, such as Information Technologies, logistics services.
1.5 Global Network

- Global business development supported by the world’s strongest network -

YASKAWA Electric Corporation HQ

Major overseas business bases
Overseas production bases

YASKAWA ELECTRIC UK LTD.
Scotland

YASKAWA NORDIC AB
Sweden

YASKAWA SHOUGANG ROBOT CO., LTD.
China

YASKAWA ELECTRIC (SHENYANG) CO., LTD.
China

YASKAWA ELECTRIC CORPORATION
Korea

YASKAWA ELECTRIC (SINGAPORE) PTE. LTD.
Singapore

YASKAWA INDIA PRIVATE LIMITED
Robotics Division
India

YASKAWA RISTRO D.O.O.
Slovenia

YASKAWA ELECTRIC CORPORATION
Japan

YASKAWA INDIA PRIVATE LIMITED
Robotics Division
India

SHANGHAI YASKAWA DRIVE CO., Ltd.
China

YASKAWA ELECTRIC (CHINA) CO., LTD.
China

YASKAWA ELECTRIC TAIWAN CORPORATION
Taiwan

YASKAWA ELECTRIC CORPORATION
U.S.A.

YASKAWA AMERICA, INC.
Motoman Robotics Division
U.S.A.

YASKAWA AMERICA, INC.
Drives & Motion Division
U.S.A.

YASKAWA ELECTRIC CORPORATION
U.S.A.

YASKAWA INDIA PRIVATE LIMITED
Drives Division
India

YASKAWA EUROPE GmbH
Robotics Division
Germany

YASKAWA EUROPE GmbH
Drives Division
Germany

YASKAWA EUROPE TECHNOLOGY LTD.
India

YASKAWA SOUMHER AFRICA (PTY) LTD.
South Africa

YASKAWA ELECTRIC (SINGAPORE) PTE. LTD.
Singapore

YASKAWA ELECTRIC (CHINA) CO., LTD.
China

YASKAWA ELECTRIC CORPORATION
U.S.A.

YASKAWA ELECTRIC CORPORATION
Taiwan

YASKAWA ELECTRIC CORPORATION
Brazil

YASKAWA ELECTRIC CORPORATION
Taiwan

YASKAWA ELECTRIC CORPORATION
South Africa

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1.6 Activity in Automated production

We proposed the assembly of Robots by Robots in 1990. At present, we achieved a 71% automation ratio in robot production.

Conceptual image of assembly line automation in 1990.

Outline of the Robot assembly line
- Light duty robot: Weight capacity 20kg
- Main application: Arc welding, Handling
- Industrial capacity: 1,000 pcs / month
- Automation ratio: 71%
- Robots in operation: 18
2. Concept of YASKAWA Version Industrie 4.0

① In-house Applications
② Expanding business to customer applications
③ Need-based new product development
④ Open-innovation

【Improve productivity of in-house production line】
Ex. Production line for Motors

【Use of own products】
Improved Robots
Industrial equipment
Improved components

【Expand market】

【Need-based new product development】

【Open Innovation】
Cloud
PLM
SaaS
Sensor

①
②
③
④

BTO
2.2 Development approach of YASKAWA’s Industrie 4.0

**【YASKAWA's Industrie 4.0 (system model)】**

1) **Distributed Control with IoT / M2M**
2) **Cloud Environment for Development**
   - Free-from Physical Constraints

**【Paradigm Shift】**

- **Hardware**
  - "Integrated" → 「Distributed」
- **Software**
  - (Traditional) "Procedural" → "Object-oriented"

**【Open Innovation towards Industrie 4.0】**

- **Product**
  - Application \(\rightarrow\) Tools \(\rightarrow\) Software \(\rightarrow\) Hardware \(\rightarrow\) Sensors \(\rightarrow\) Mechanisms
  - CRM
  - CAD
  - PDM
  - MES
  - ERP
  - Customer Management
  - Developing Environment
  - Supply-chain

- **PLM**
  - Consistent Management for the Development

Open innovation at every stage boosting both product development and BTO production

BTO: Build-to-Order
3. Future Production – Coexistence with Robot –

In future production lines, Robots will learn skills corresponding to a specific task from cloud based applications, and will work hand in hand with human.

Future image of coexistence of cell with robots

Practical Image

- JOB motion change
- M2M communication with parts
- Parts①: ID1
- Parts②: ID2
- Parts③: ID3

In case of handling task other than the usual one, there is a need to change operation
=> Inquire to Cloud, and perform task by acquiring motion applications.
3.2 Example of cloud Robotics

Cloud Robotics Applications

- Failure prognosis and Remote maintenance
- Remote teaching; Path planning
- Shared open application software (SaaS) in multitenancy environment
- Parameter tuning; Autonomous learning

Wireless pendant

Smart devices; Information Visualization

Server in factory

Cloud
3.3 Demonstration: Robotics for BTO manufacturing

Robotics realizing Build-to-Order (BTO) manufacturing, and Remote Monitoring of the production line.

Blocks are rearranged as per specific order.
4. Expectation for Industry Segments

- Non-overconcentration
- Healthy competitive environment
- Growth of industry as a whole

System integrator
Software vendor
Components
Parts
Thank you for your attention